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DMC Systems for Rice-Beef Production in the Plain of Jars, Xieng Khouang Province, Lao PDR: An Example of "Creation-Validation" Methodological Approach

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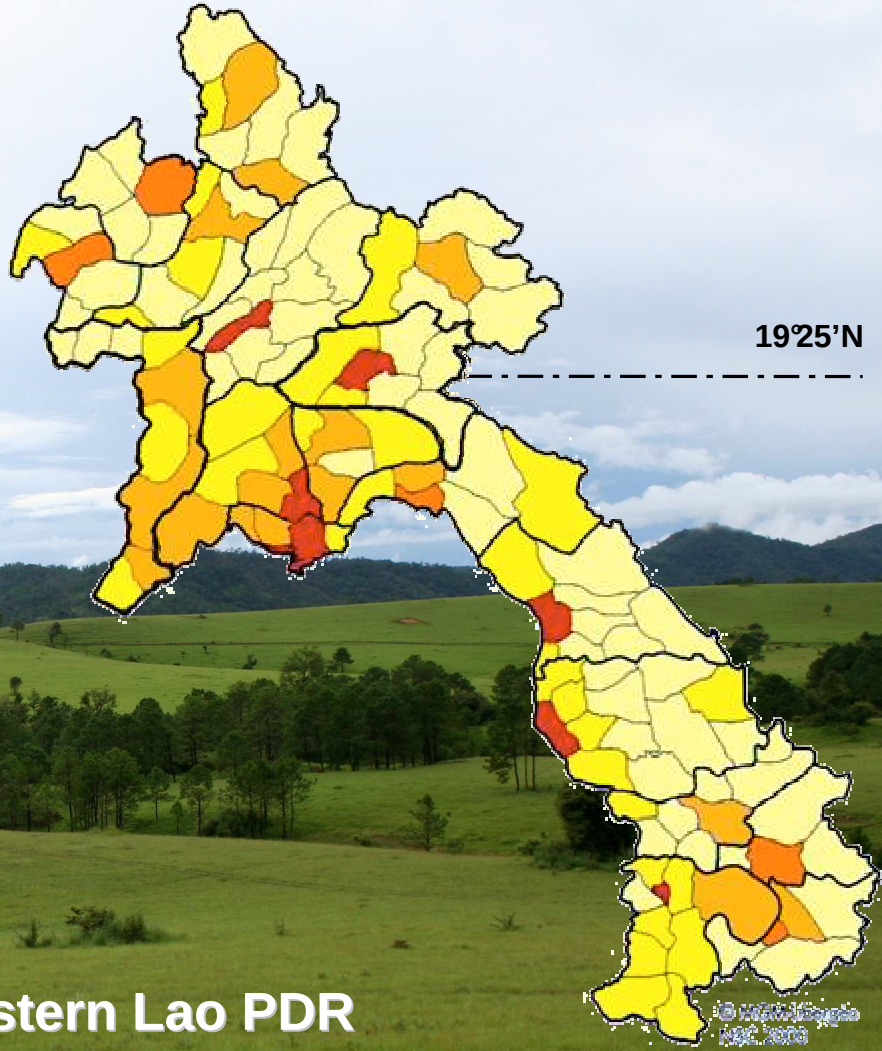
Location and main characteristics



Plain of Jars (900-1200m)

- Xieng Khouang province, North-eastern Lao PDR
- 3 main districts concerned (Pek, Phoukout and Paxay)
- About 60.000 ha of acid infertile savannah grasslands
- Low pH (5.0) and deficiencies in main nutrients (NPK, Ca et Mg)
- Severe Aluminium toxicity

Main farming systems & current rural development strategies

Plain of Jars (900-1200m)

- Only 5% of total surface is cultivated, 80% in paddy rice
- Main farming system: rice production in the paddy land and extensive livestock production on the hills

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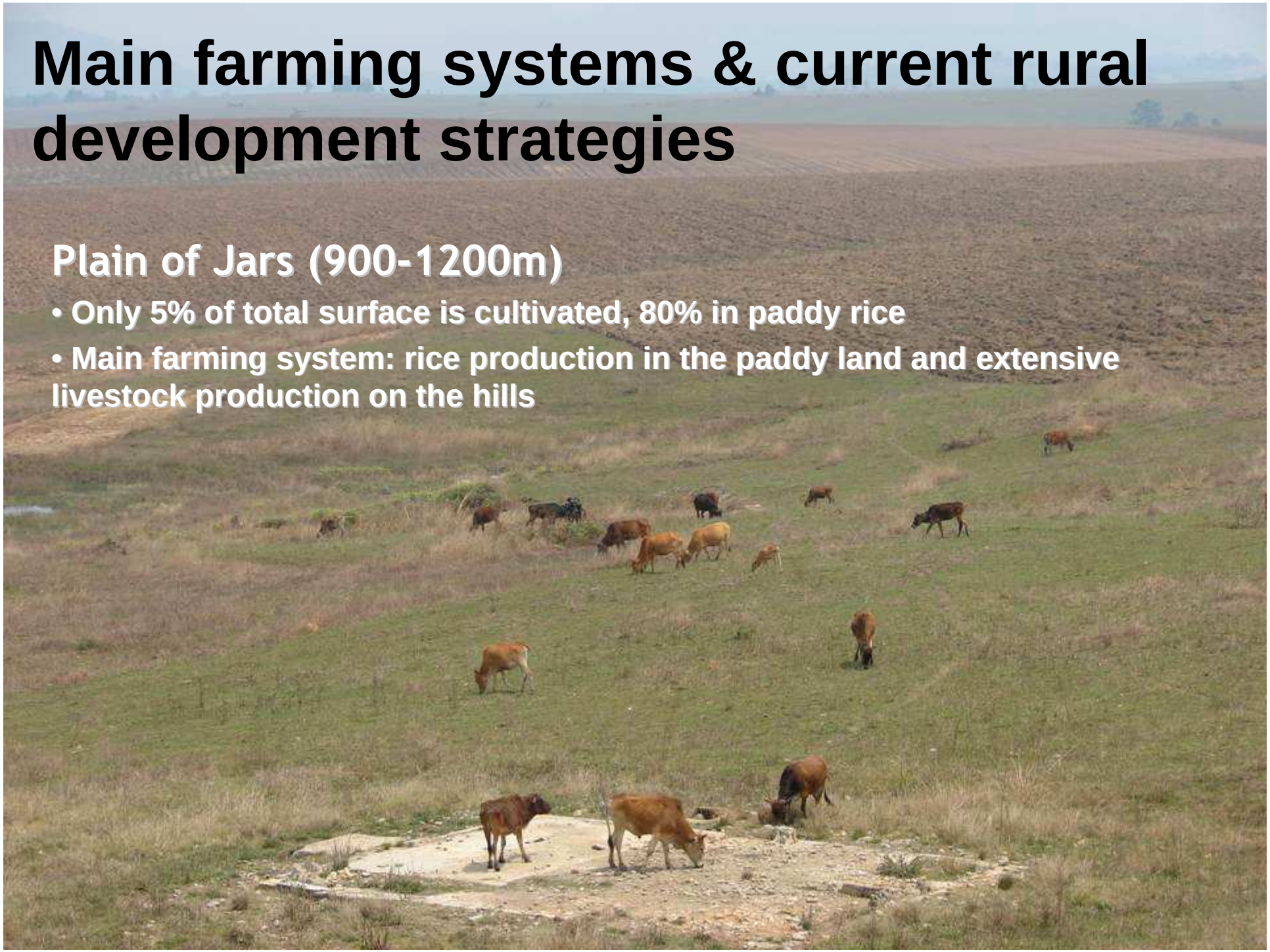
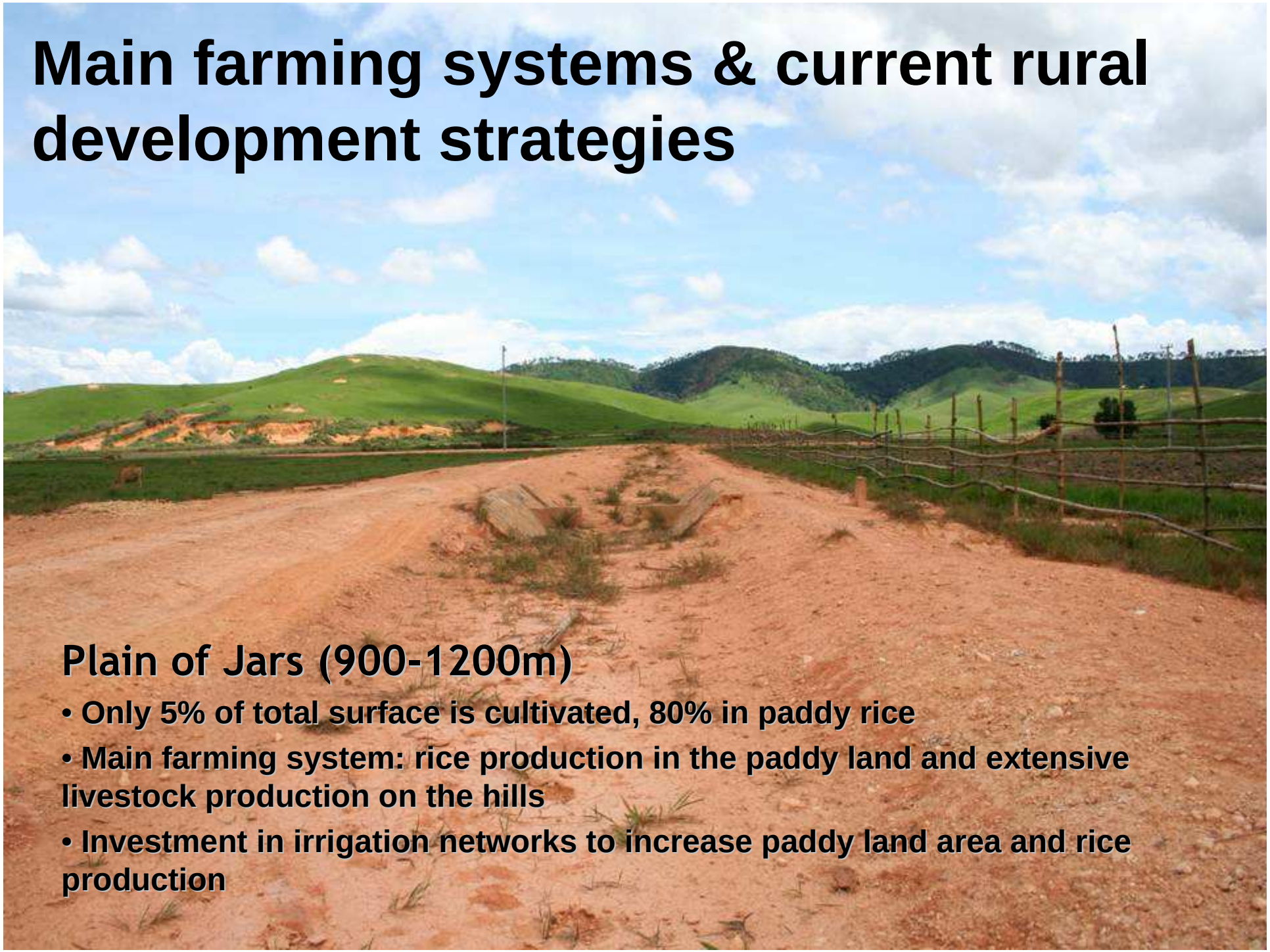


Main farming systems & current rural development strategies



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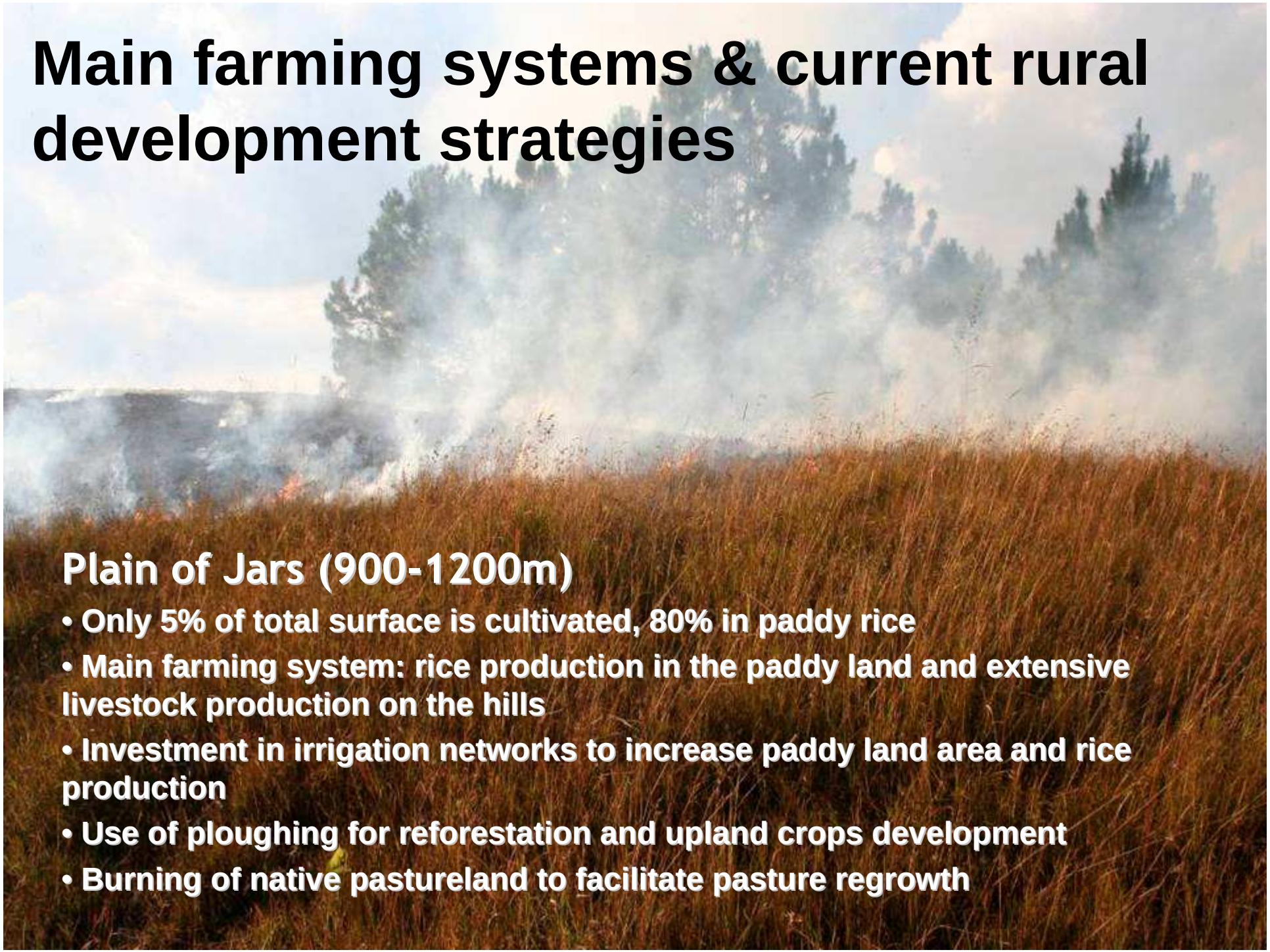

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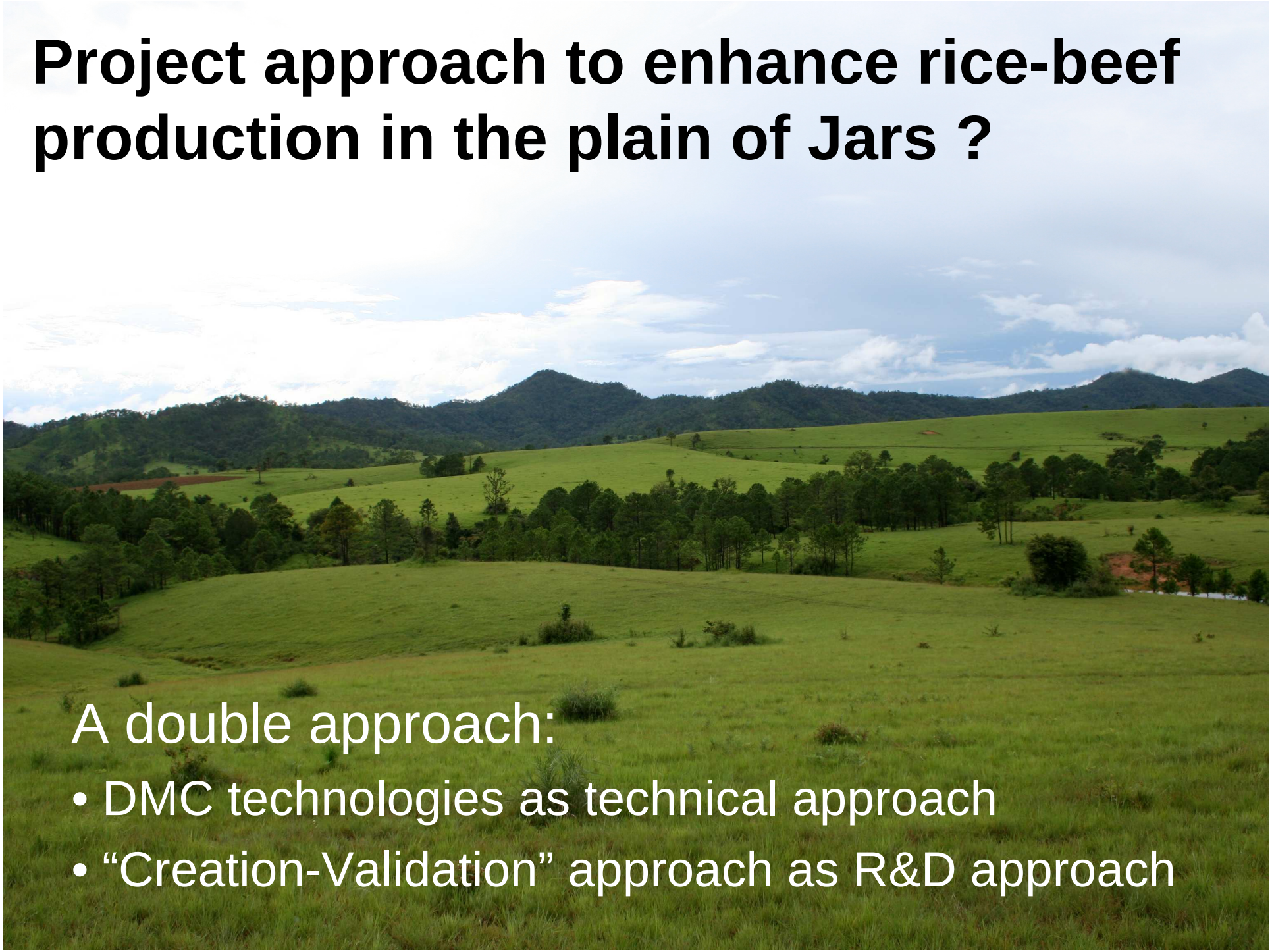
Main challenges for Agriculture

2 priorities for the government:

- Increase Rice production
- Develop Cattle industry

Project approach to enhance rice-beef production in the plain of Jars ?



A double approach:

- DMC technologies as technical approach
- “Creation-Validation” approach as R&D approach

What is Conservation Agriculture and Direct Seeding Mulch-Based Cropping System (DMC)?

3 principles:

Permanent soil cover

Minimum soil disturbance (no tillage) and no burning

Diversified crop rotations

"CREATION-VALIDATION" APPROACH
5 interdependent components

Initial assessment

- Physical, human and economical environments
- Typology of Farming Systems

Reference data acquisition

- Long-term experiments in creation sites
- Generation of a large basket of technologies
- Characterization of biological and physicochemical processes (soil fertility evolution)

Adaptation and validation with smallholders

- On-farm experiments with farmers groups
- Scale: plot, village and landscape level
- analyses of the conditions for adoption

Training and Communication

- Various supports for various publics (farmers, extension agents and researchers)
- Information for policy-makers and stakeholders

Monitoring and Evaluation

- Feed-back for R&D
- Methodological tools for R&D approach
- Evaluation of constraints/potential for extension

METHODOLOGY: CREATION-VALIDATION APPROACH
5 interdependent components

- Initial assessment
- Reference data acquisition
- Adaptation and validation with smallholders
- Training and Communication
- Monitoring and Evaluation

Specificity of the approach:

- Several validation steps with farmers groups
- Important feed back between research in creation sites and validation in Farmers groups

Research topics and reference data acquisition in Creation sites

Topics	Data collection
"Direct Seeding of Improved forage species on degraded Pastureland"	• Species collection x fertilisation • Above ground and below ground biomass production (forage adaptability) • Fodder quality (protein content) • Seeds production
"Cattle Fattening activities"	• Benefits/costs analysis • Average Animal Daily Growth Rate (DGR) assessment • Easy tools for GR monitoring without balance
"Regeneration of improved pastureland using rice as a cash crops"	• Cropping systems (rice cultivars x species association modalities x fertility) • Technical feasibility • Benefits/costs analysis

5-year rotational sequence initially proposed to enhance rice-beef production in the Plain of Jars

1st year: Improved pasture land implementation

- Use of Brachiaria ruziziensis as improved forage specie
- No animal grazing or ruzi grass exportation to insure good pasture implementation
- Forage seeds collection and sale to cover improved pasture land implementation costs

5-year rotational sequence initially proposed to enhance rice-beef production in the Plain of Jars

2nd to 4th year: Fattening of young bulls

- Direct grazing is advised (vs forage cut & carry) to provide nutrients return to the soil through animals dejections
- Pasture plot is divided in 4 blocks to provide 4-grazing period per month and allow best protein content in the forage leaves

5-year rotational sequence initially proposed to enhance rice-beef production in the Plain of Jars

5th year: Direct seeding of rice as a cash crop to finance improved pastureland re-installation

5-year rotational sequence: Costs/Benefits expected

Cost / Benefit simulation was made as follow:

First year: Improved pastureland implementation:

• Plot fencing: use of local material (wood, bamboo); only labour is recorded
• Pasture land implementation cost: land preparation (30 US$/ha) + Seeds (35 $US/ha) + Operational costs (35 $US/ha)
• Fertilization: 60-80-60 kg of NPK/ha, total cost of 120 $US/ha
• Credit requirement: All pastureland implementation cost, credit interest of 12%/year during 9 months (from sowing to harvest and drying of the seeds)
• Seeds production: 140 kg/ha for ruzi grass seeds at 1,5$ US/kg

2nd to 4th year: Bulls fattening activity

• Inflation rate (all products): 5%/ year
• Bulls stoking rate: 4 animals/ha, initial price of 150 $US for a bull of 110-120 kg (1,2 $US/ living kg)
• Bulls fattening: fattening period of about 5,5 months; average growth rate of 15 kg/animal/month, ie gain of 80 to 90 kg/Al/fattening period
• Credit requirement: credit for buying 2 bulls (the 2 other ones are coming from owm farmer herd)+ fertilizer at interest level of 12%/year for 6 months

5th year: Pasture re-establishment using rice as a cash crop

• Rice + Pasture sowing cost: land preparation (40 US$/ha) + Seeds (60 $US/ha) + Operational costs (40 $US/ha)
• Rice production: 1,8 T/ha at 220 $US/T

5-year rotational sequence: Costs/Benefits expected

Plot of 1 ha	1st year	2nd year	3rd year	4th year	5th year
	Pastureland implemen.	Bulls fattening	Bulls fattening	Bulls fattening	Pastureland re-establishment
COSTS (US $)	**240**	**765**	**803**	**842**	**303**
Plot fencing and designing	nd	nd	nd	nd	nd
Pastureland implementation	100	0	0	0	140
Fertilizer	120	125	132	139	146
Animals & animals care	0	615	645	675	0
Credit requirement	220	420	440	470	286
Credit interest	20	25	26	28	17
LABOUR (md.ha-1)	**68**	**72**	**62**	**62**	**55**
Fencing & Fence maintenance	30	20	10	10	10
Crops implementation and management	8	2	2	2	10
Seeds harvesting	30	0	0	0	35
Bulls management	0	50	50	50	0
BENEFITS (US $)					
Bulls sale	0	1 000	1 050	1 100	0
Seeds production	210	0	0	0	395
GROSS INCOME (US $)	**210**	**1 000**	**1 050**	**1 100**	**395**
NET INCOME (US $)	**-30**	**235**	**247**	**258**	**92**
LABOUR PRODUCTIVITY (US $/ wd)	**-0,44**	**3,26**	**3,98**	**4,16**	**1,67**

5-year rotational sequence: Costs/Benefits expected

- **Total net income on the 5 years: 800 $US/ha**
- **Average net income of 160 $US/ha/year**
- **Average production costs of 591 $US/ha (bulls included)**
- **Average net income represent 27% of average production cost (risk factor)**
- **Average labour productivity of 2,53 $US/working day**

Validation process: the different steps…

Topics	1st step	2nd step	3rd step
	• Technical (training, technicians, equipment) & financial (credit) support provided • Financial risk shared with farmers (security if failure)	• Technical & financial support provided • Financial risk **assumed** by farmers	• Technical support provided • Financial support provided by **banking sector** • Financial risk assumed by farmers
"Direct Seeding of Improved forage species on degraded Pastureland"	• 2006: 6 villages, 6 farmers groups, 24 farmers, 14 ha	• 2007: 12 villages, 13 farmers groups, 68 farmers, 62 ha	• 2008: Partnerships initiated with NNRBDP and Agri. Dev. Bank
"Cattle Fattening activities"	• 2007: 6 villages, 6 farmers groups, 24 farmers, 14 ha	• 2008: 12 villages, 13 farmers groups, 70 farmers, 62 ha	
"Regeneration of improved pastureland using rice as a cash crops"	• Not yet started with farmers groups		

Validation process: data collected…

1- On-field monitoring

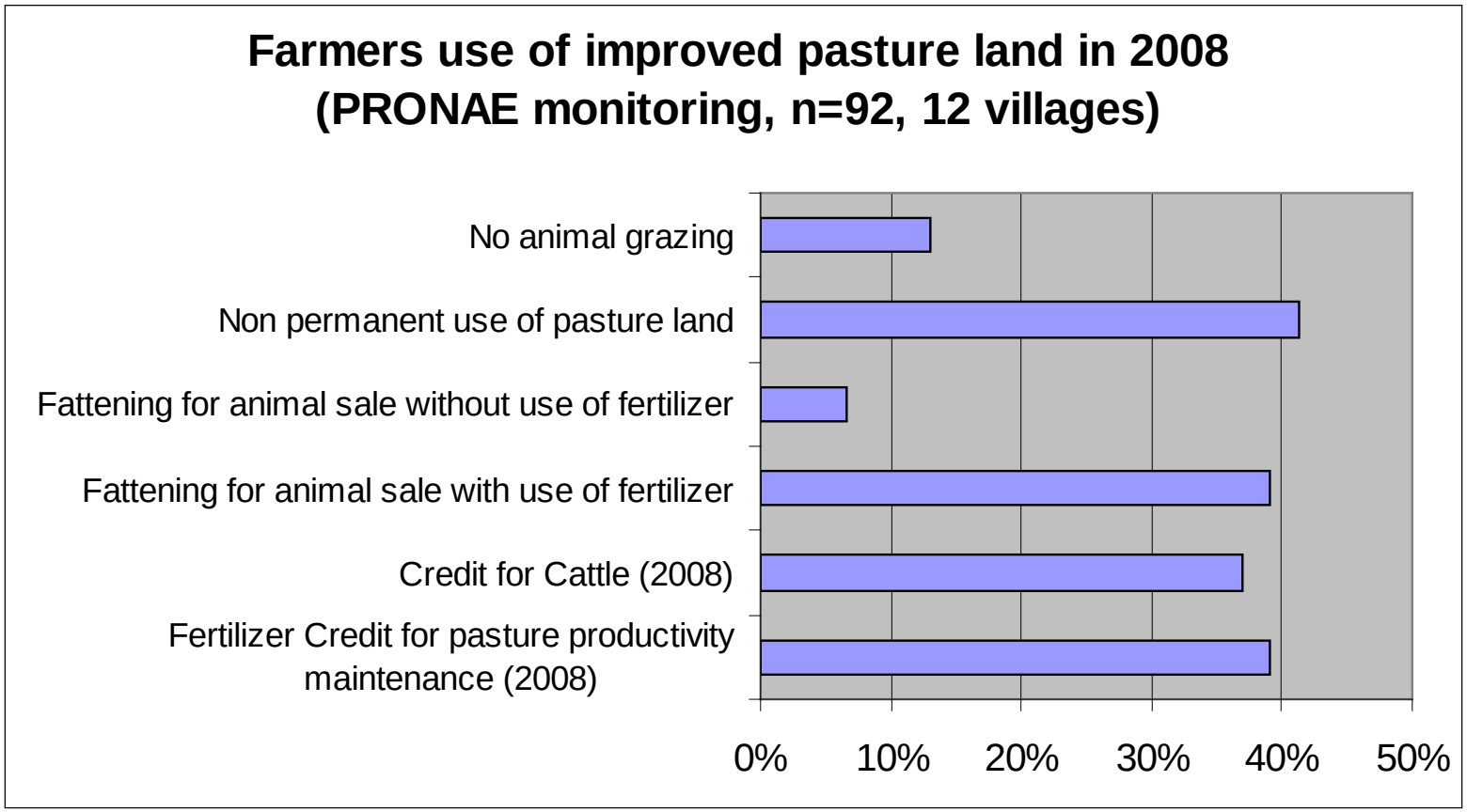
- Technical feasibility by farmers (skills required for equipment, fertilizer use etc.)
- Forage seeds production
- Stoking rate management
- Animal Daily growth monitoring

2- Farmers point of view assessment

- 2 meeting with farmers (june 2007 & august 2008)
- Farmers point of view assessed using PRA methods

Lessons learnt from Validation process…

Improved pastureland use assessment after 3 years of *in situ* validation with farmers groups

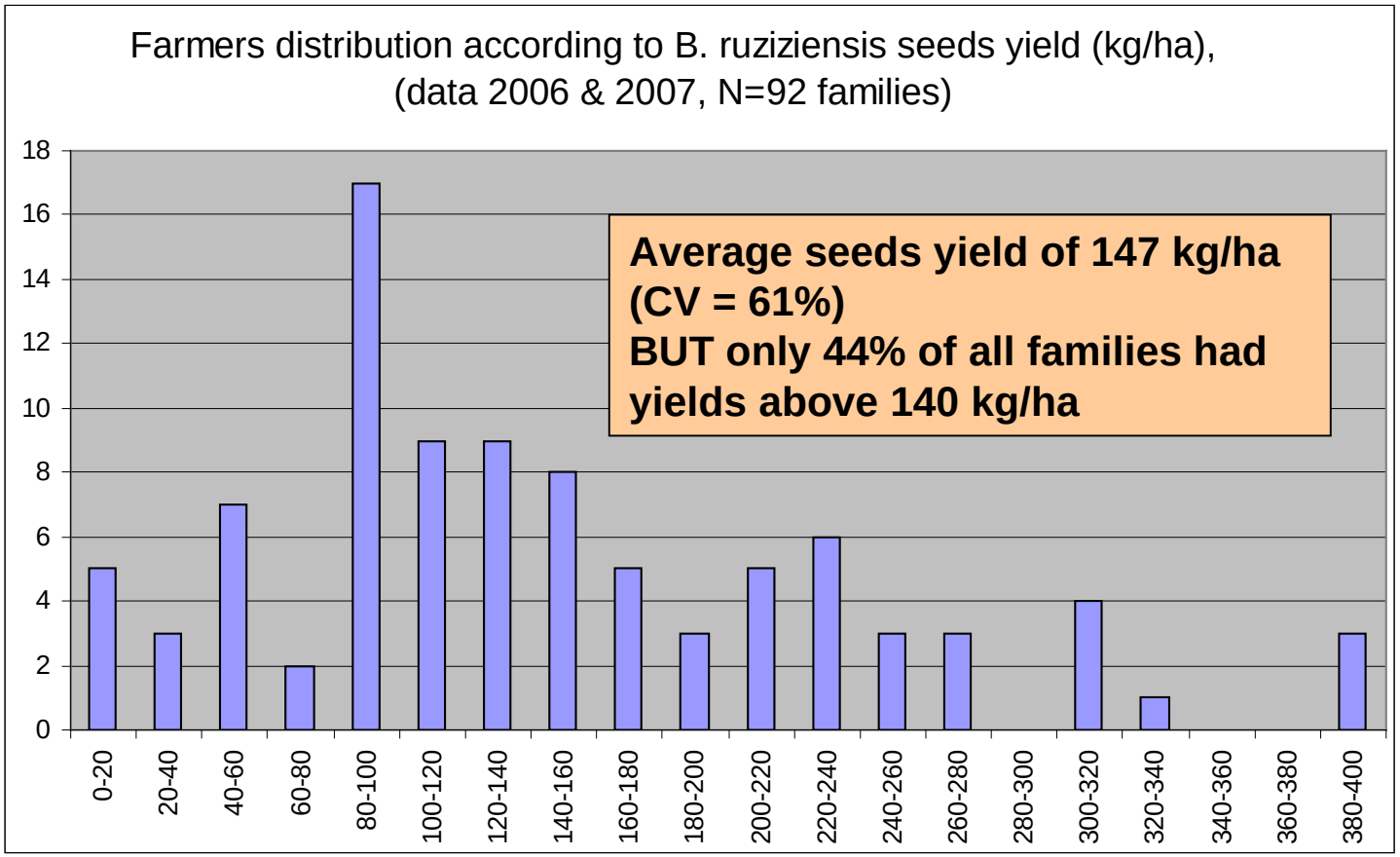


Only 39% of farmers are using improved pastureland as initially expected

Lessons learnt from Validation process...

Main constraints during the first year for improved pastureland implementation:

(i) Forage seeds yield required to cover implementation costs



Lessons learnt from Validation process…

Main constraints during the first year for improved pastureland implementation:

(i) Forage seeds yield required to cover implementation costs

Yield limitations due to unexpected local weather conditions…

"Forage yield were very low due to frost problem"
(Farmers from Khay and Viengxay village)

"Forage is dead due to flood"
(Farmers from Latbouak village)

Lessons learnt from Validation process…

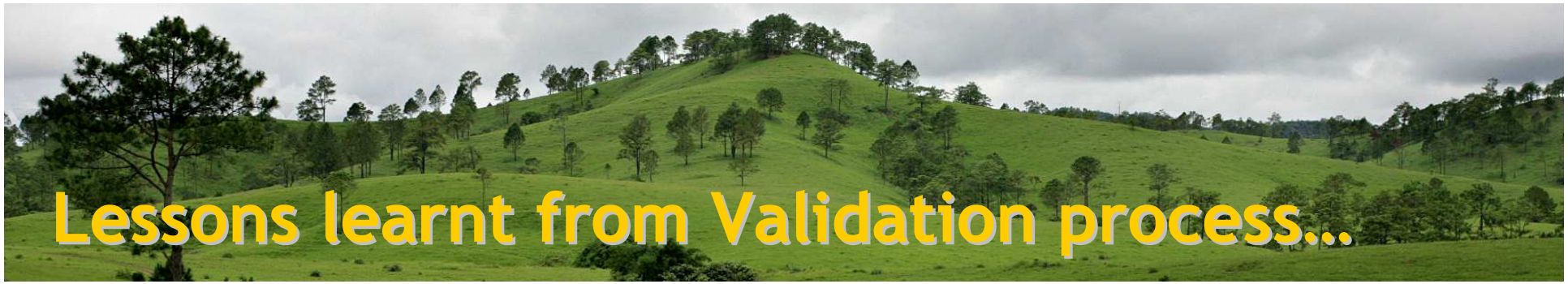
Main constraints to be:

- Market channel constraints…

Forage seeds market limitations

"We still have forage seeds we collected but no one to buy it"

(Farmers from My and Khangpeung village)



Lessons learnt from Validation process…

Main constraints to be:

- Market channel constraints…

… or malfunctioning (cattle)

"I don't have animals to do fattening" ***(Farmer from Ngoy village)***

- Animal availability

"It is difficult to find young bulls for purchase" ***(Farmer from Xoy Nafa village)***

- Farmers / traders interactions

"It is difficult to sale animals at a good price: traders propose us lower animal weigh unit price *[kips/ living kg]* that what we paid when we bought them! ..." *(Farmer from My village)*

"Traders tell us that this is now difficult to sale in Vietnam, but we don't know!" ***(Farmer from Khangpeung village)***

"We need contract with traders to buy and sale animals at a defined price" ***(Farmers from My village)***

Lessons learnt from Validation process…

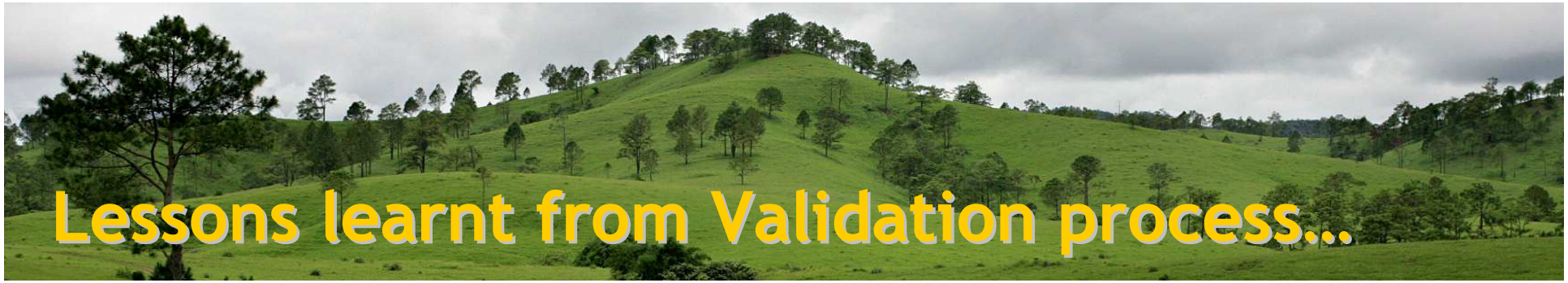
Main constraints to be:

(ii) Fencing costs and maintenance

"Bamboo fence are not solid enough ; cattle can easily penetrate and destroy the forage plot ; if we use barber wire, it is expensive and then it's difficult to pay back the credit and even save money"

(Farmers from Xoy Nafa village)

A 4-line barber wire with wood pots fence cost an average price of 270 $US/ 400m (ha)

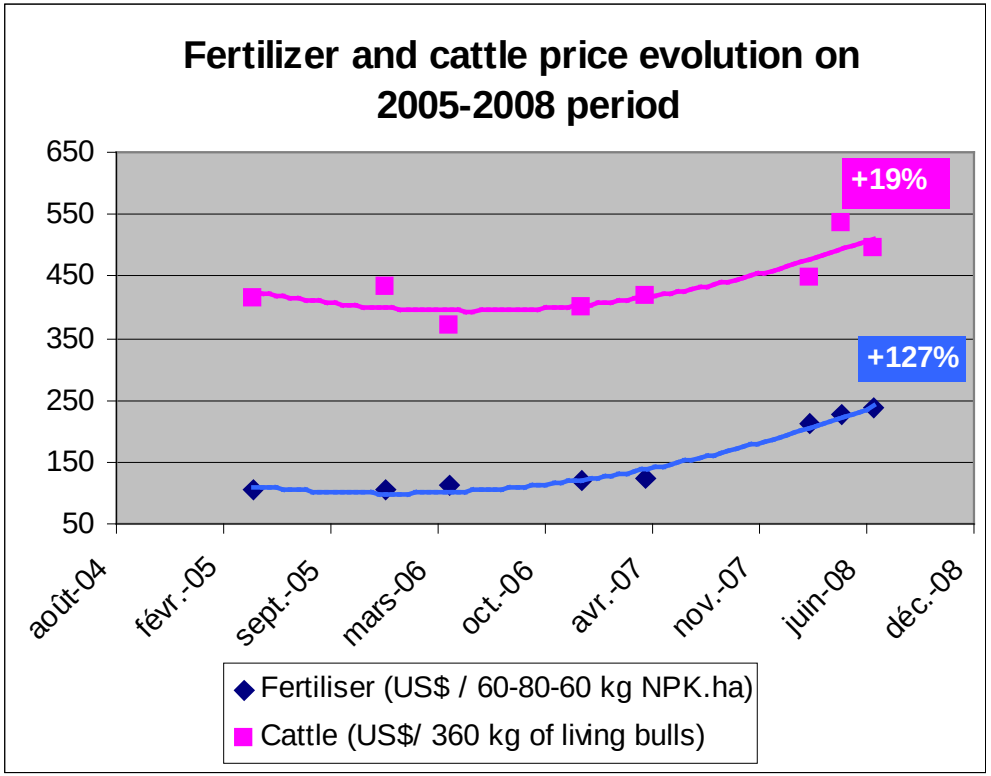


Lessons learnt from Validation process…

Main constraints to be:

(iii) Unequal inflation rates between inputs and outputs

Fertilizer cost has been increasing of 127% since 2005 (in relation with oil crisis) while cattle weight unit price was only increasing of 19%



Lessons learnt from Validation process…

Main constraints to be:

(iv) credit access, amount and payment modalities

- Credit access
- Credit interest rate
- Credit amount
- Credit length
- Credit payment modalities

"If you can not provide financial guaranties, you can not get any credit" *(Farmers from Nakhouan village)*

"Procedures to get a credit are too complicated" *(Many farmers)*

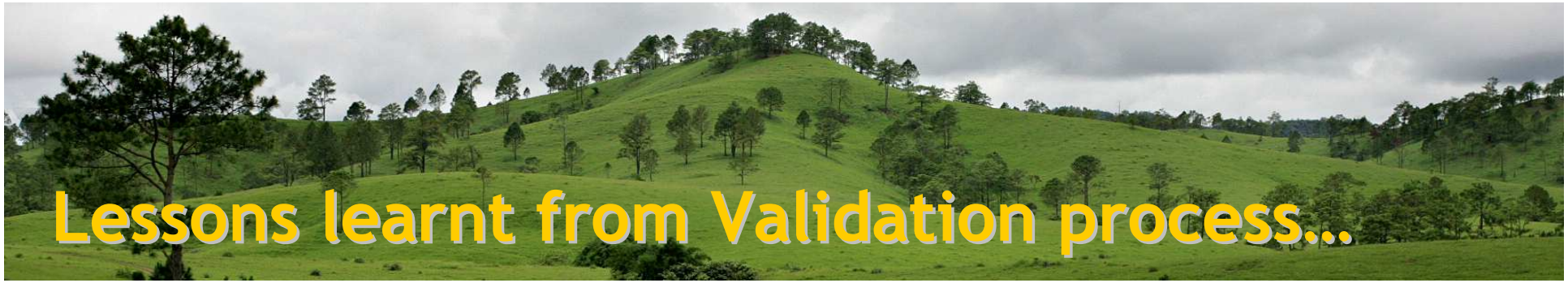
"Credit interest is too high! We need reduced interest rate for animal raising" (*All farmers)*

"Credit amounts proposed are too limited; we need higher credit amount for animal purchase" *(Farmers from My and Pouhoum village)*

"Credit length proposed is too short; we need long-term credit for animal raising" *(Farmers from Khay village)*

"You ask for a credit and then money arrive 3 months later; it's too late!" *(Many farmers)*

"Money disbursement is too slow" (*Many farmers)*



Lessons learnt from Validation process…

Main constraints to be:

(v) Technical skills required for good-quality pastureland implementation

"Forage establishment was bad due to important delay between land preparation and forage sowing"

(Farmers from Gnapsy village)

"There are many weeds in my forage plots since they were not well controlled before forage sowing"

(One farmer from Leng village)

Discussions and proposals were made on:

(i) Credit access: discussions between Provincial Agricultural and Forestry Office, Nam Ngum Development Project and Xieng Khouang Agricultural Development Bank (ADB) have allowed to:

- replace financial individual guaranties with collective ones (farmers group)
- decrease credit interest rate for animal raising from 15 to 12% a year
- propose an average amount of 7.000.000 kips (800 $US) to farmers involved in Cattle fattening activities

(ii) Cattle market channel malfunctioning: visits and exchanges between traders and farmers have been scheduled

(iii) VCD Training supports (what to do and what not to do) are under process

Feed back benefit for Research…

This feed back as also given rise to new research topics:

(i) How to reduce fertilizer use (main production cost) ?

(ii) How to generate higher incomes during the first year of implementation?

Feed back benefit for Research…

New farming systems have been developed based on:

- Direct sowing, the first year, of rice associated with forage species directly on degraded native pastureland
- Use of mix fodder species (ruzi grass associated to stylosanthes guianensis CIAT 184, a perennial legume fodder able to fix N from the atmosphere)

New system should allow to:

- include fencing cost (bamboo fence associated with living species)
- stop system dependence regarding forage seeds market
- get positive net income from the 1st year

New system cost/benefit simulation

Cost / Benefit simulation was made as follow:

First year: Rice + forage implementation:

• Plot fencing: use of local material (wood, bamboo) and seedlings for living fence
• Pasture land implementation cost: land preparation (35 US$/ha) + Seeds (rice 30 $US/ha and forage 60$/ha) + Operational costs (40 $US/ha)
• Fertilization: 60-80-60 kg of NPK/ha (total cost of 240 $US/ha) with Bo, Mn and Zn the first year (50 $US/ha)
• Credit requirement: All pastureland implementation cost, credit interest of 12%/year during 6 months (from sowing to rice harvest)
• Rice production: 1,8 T/ha at 320 $US/T

2nd to 4th year: Bulls fattening activity

• Inflation rate (all products): 5%/ year
• Bulls stoking rate: 4 animals/ha, initial price of 180 $US for a bull of 110-120 kg (1,2 $US/ living kg)
• Bulls fattening: fattening period of about 5,5 months; average growth rate of 15 kg/animal/month, ie gain of 80 to 90 kg/Al/fattening period
• Credit requirement: credit for buying 2 bulls (the 2 other ones are coming from owm farmer herd)+ fertilizer at interest level of 12%/year for 6 months

5th year: Pasture re-establishment using rice as a cash crop

• Rice production: 2,2 T/ha at 390 $US/T

New system cost/benefit simulation

Plot of 1 ha	1st year	2nd year	3rd year	4th year	5th year
	DS of Rice + forage	Bulls fattening	Bulls fattening	Bulls fattening	Pastureland re-implem (rice+forage)
COSTS (US $)	**542**	**1 044**	**956**	**998**	**573**
Plot fencing and designing	60	20	20	20	20
Crop implementation	165	0	0	0	230
Fertilizer	290	252	135	140	292
Animals & animals care	0	735	770	805	0
Credit requirement	455	620	520	543	522
Credit interest	27	37	31	33	31
LABOUR (md.ha-1)	**73**	**72**	**62**	**62**	**60**
Fencing & Fence maintenance	30	20	10	10	10
Crops implementation and management	8	2	2	2	10
Seeds harvesting	35	0	0	0	40
Bulls management	0	50	50	50	0
BENEFITS (US $)					
Bulls sale	0	1 360	1 430	1 500	0
Seeds production	575	0	0	0	860
GROSS INCOME (US $)	**575**	**1 360**	**1 430**	**1 500**	**860**
NET INCOME (US $)	**33**	**316**	**474**	**502**	**287**
LABOUR PRODUCTIVITY (US $/ wd)	**0,45**	**4,39**	**7,64**	**8,10**	**4,78**

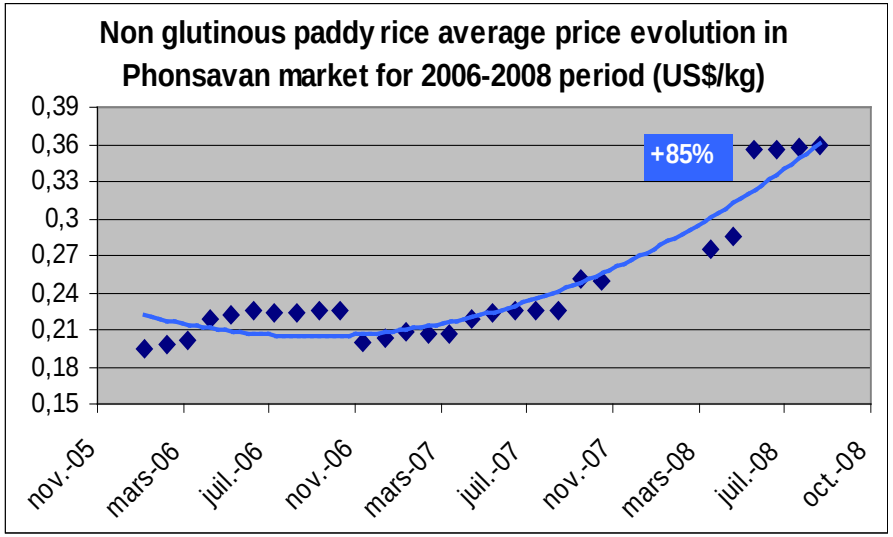
New system cost/benefit simulation

- **Total net income on the 5 years: 1145 $US/ha**
- **Average net income of 322 $US/ha/year**
- **Average production costs of 823 $US/ha (bulls included)**
- **Average net income represent 39% of average production cost (risk factor)**
- **Average labour productivity of 5,1 $US/ha/working day**

Other DMC systems under evaluation for the plain of jars: the rice-stylosanthes 2-years rotational sequence

Regarding:

- good technical results obtained in creation site with direct seeding of rice on degraded pastureland,
- Paddy rice increase (+85% since beginning of 2006)



Rice-stylo 2-years cropping system could be another intersting system for the Plain of Jars with:

- A production of rice every 2 years on the same plot
- A steady increase of soil fertility related to stylo cover
- Lower production costs and credit need

Rice-stylosanthes cost/benefit simulation

Plot of 1 ha	1st year	2nd year	3rd year	4th year
	DS of Rice + stylo	Stylo santhes	Rice DS on Stylo mulch	Stylo santhes
COSTS (US $)	**500**	**20**	**396**	**20**
Plot fencing and designing	60	20	20	20
Stylo-rice crops implementation	125	0	90	0
Fertilizer	290	0	265	0
Credit requirement	415	0	355	0
Credit interest	25	0	21	0
LABOUR (md.ha-1)	**73**	**12**	**63**	**12**
Fencing & Fence maintenance	30	10	10	10
Crops implementation and management	8	2	8	2
Rice harvest	35	0	45	0
BENEFITS (US $)				
Paddy rice	575	0	875	0
GROSS INCOME (US $)	**575**	**0**	**875**	**0**
NET INCOME (US $)	**75**	**-20**	**479**	**-20**
LABOUR PRODUCTIVITY (US $/ wd)	**1,03**	**-1,67**	**7,60**	**-1,67**

Rice-stylo system presently under evaluation with farmers groups

CONCLUSION

This rice-beef system “creation-validation” process shows:

(i) the need to maintain research activities into the development process and,

(ii) the merits of the “creation site / farmer validation group” system for determining the potential for technology dissemination.


Thank you for your attention !